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Enhancement of Performance Metrics of Heterogeneous Wireless Camera Sensor Network with Functionalization of Extensive Zonal Stable Election Protocol using Threshold Amplification and Residual Energy

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Abstract— We report a new improved energy competent and optimized data packet flow protocol with Hierarchical Clustering utilized in Wireless camera Sensor Network.The existing Extensive Zonal Stable Election Protocol has been modified along with the threshold parameters amplification and residual energy. It incorporates dynamic hybrid method with finite number of Member Sensor nodes (MSN) in proximity with the base station share their data directly , while the rest of the farther nodes form a cluster for data transference using Cluster Head. The performance metrics accompanied by heterogeneity, longer network survival and better throughput have been improved. The network field was divided into 4 zones with a gateway for defined region 2, 3, and 4. The criterion for zone division remained on the energy status (residual) of the MSNs and distance from the BS and the formulated field characteristics in the simulation were kept unknown. The obtained results demonstrate that our proposed modified version of EZSE protocol considerably performs better than existing EZ-SEP, Z-SEP, SEP, LEACH, Mod-Leach protocols during entire stability timeframe. The notable achievement is also reported in throughput as the same is enhanced more than by ~ 39%, 43%, 49% ,56%, 53% while total packets communicated with base station has been increased more than by ~ 127%, 131%, 147%, 151%, 148% stability of the network is also improved more than by ~ 37%, 42%, 45%, 49%, 51% with the corresponding increase in the heterogeneity of networks.

Keywords- Clustering, Low Energy Adaptive Clustering Hierarchy, Stable Election Protocol, Wireless Camera Sensor Network, Throughput.

I. INTRODUCTION

In the contemporary world, we see that wholly information processing device in our hand is totally wireless dependent. The problem remain though is the limited bandwidth of the available spectrum in which we are communicating. The next thing that worries the researchers is the pool of finding ways to set up Now combining the both conditions where we need to efficiently utilize the channel available (upgrade every possible thing for the transmission and during the transmission) and have to make sure that the network setup is providing optimum results in terms of:

1. Power
2. Energy usage and its consumption
3. Load matching
4. Data transmission
5. Life of the overall network
6. Security of the data transmission
7. Cost effective

Since we know that because of limited Bandwidth we need to trade off on several aspects during the communication, but ensuring the same for a network without human interference during the transmission requires lots of pre-requisite.

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So, we need to combine effective routing schemes and implementation structures of the wireless networks which are good to work in collaborative manner like cooperative diversity.

S.no	Key words	Full forms/Description
1	MSN	Member Sensor Nodes
2	CH	Cluster Head
3	E(initial)	Initial MSN Energy
4	P (op)	Optimum Probability of election
5	LEACH	Low Energy Adaptive Clustering Hierarchy [14]
6	SEP	Stable Election Protocol [14]
7	Z-SEP	Zonal Stable Election Protocol [14]
8	DEEC	Distributed Energy Efficient Clustering [16]
9	BS	Base Station
10	EZ-SEP	Extended Zonal Stable election protocol

Abdelkader Benelhouri et. al [1] provided gateway-based procedure for extending network time to go in dead state in a homogeneous WSN by segmenting the network into multiple fields has been developed and demonstrated. The network was divided into various fields to achieve this.

J. Wang and X. Zhang [20] had proposed the AQDBPSK/ DS-CDMA scheme, which is based on energy associated proficiency and interference associated extenuation for 3D modeled approach of grouping of MSN in wireless communications sensor networks, with the minimized desired subject rate of coverage constraint applying NEW LEACH architecture for energy effectiveness and interference alleviation following the Nakagami-m model.

Aria Nosratinia et. al [3-6] has given a concept of Cooperative communication became the talk of the research proposing single-antenna devices in multi-user environment to share their antennas and generate a virtual multiple antenna transmitter that allows them to achieve transmit diversity.

Jigisha Parmar et. al [7-8] gave a number of applications for wireless sensor networks, including environmental monitoring. The LEACH, TEEN, and APTEEN vital clustering methods were used in this application to analyze the light intensity, temperature, pressure, and humidity levels of the sensor data as well as their variations.

Neha Rathi et. al [9-10] proposed to make the sensor network last longer. The use of hierarchical based techniques and gradient based routing has demonstrated superior benefits in terms of scalability and effective communication. Multipath routing has solved the issue with the Single-Path Routing Approach.

Payal Jain et. al. [11-12], LEACH and PEGASIS are contrasted in the article based on energy efficiency and lifespan. Their comparison showed a significant improvement trade-off in the life span of individual SNs as well as the overall Network based on energy efficiency in LEACH and power optimization in PEGASIS.

Hooggar, M. et. al. [13] A novel algorithm for achieving three-dimensional coverage in wireless sensor networks with three-dimensional topology has been proposed. The authors of this study have introduced an algorithm that utilises their newly developed three-dimensional clustering algorithm. Two coverage methods were proposed, namely full coverage and overlap avoidance. The conventional network implementation has demonstrated a range of 59% to 89% reduction in energy consumption. However, the coverage algorithm proposed in this study yielded varying results, with energy savings ranging from 14% to 75% upon modification of the cluster size.

H. Kiwan et.al [8], [14] gave concept over individual engaged in the operation of a substantial network that incorporated the hierarchical network model. The methodology employed in conjunction with the protocols was comprehensively examined, furnishing a satisfactory elucidation of the merits and demerits of each protocol. This paper provides an explanation of hierarchical network routing. The utilization of hierarchical routing is proposed as a viable resolution to address the issue of managing large-scale networks, as demonstrated through an illustrative example. Specific hierarchical network routing algorithms are succinctly compared. The paper provided a concise overview of several clustering algorithms.

II. WIRELESS SENSOR NETWORKS

Wireless Sensor Networks are established using diminutive electro-mechanical devices, commonly referred to as "Member sensor nodes." Sensor nodes establish connectivity with one or more potent sinks, commonly referred to as base stations, via RF signals (BSs). Communication can be classified into two types: one-way communication and two-way or multi-way communication. Sensor networks are classified into two categories based on their operational mechanisms, namely proactive networks and reactive networks. Passive networks are a suitable option for data aggregation due to the regular sensing and transmission of data by the nodes. In contradistinction to passive networks, reactive networks are characterized by sensor nodes that exhibit prompt responsiveness solely to significant parameter alterations. Reactive networks are a more suitable

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option for applications that require expeditious completion. In order to enhance the longevity of sensor networks, it would be advantageous for sensor nodes to collaborate with one another. Transceivers may possess any of the four states, namely Transmit State, Receive State, Idle State, and Sleep State, as additional features. Sensors derive their power from either batteries or capacitors. The final component is the Memory unit, which is responsible for storage. Typically, sensors possess storage capabilities in units of kilobytes, Flash Memory, and Random Access Memory (RAM), among others. [5] [6] The categorization of sensor nodes into four generations is based on their respective levels of obtrusiveness. The aforementioned categories are denoted as Obtrusive, Parasitic, Symbiotic, and

biohybrid. Obtrusive devices are characterized by their considerable dimensions and mass, comparable to that of a standard shoe box. Portable devices have the potential to cause inconvenience, as evidenced by wearable cameras equipped with sensors for body tracking and halter electrocardiographs. Their performance is restricted due to the significant amount of power dissipation. [3] [4] [5]

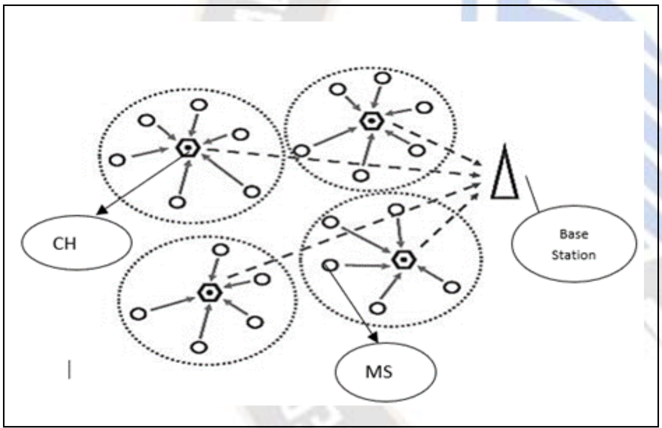

Figure 1 Wireless Camera Sensor network Setup

III. CLUSTERING

The procedure of grouping of nodes involves the consolidation of relevant data, whereby the head of the group (CH) is accountable for transmitting the data as opposed to a group of sensors, as stated in reference [6]. The implementation of a hierarchical network follows a specific structure. In a hierarchical based network architecture, MSNs are prearranged in a manner that assigns varying degrees of importance to them. This is in contrast to a flat network architecture, where all nodes are considered equal in terms of their responsibilities. The utilization of clustering involves the implementation of a hierarchical approach that is consistent with previously established methodologies [5][6]. In contradistinction to cluster heads, who occupy a superior hierarchical position, cluster members situated at a subordinate level gather sensed attributes from other cluster members. The sensory characteristics will be consolidated by cluster heads, subsequently transmitting this data to either base stations or higher level cluster heads, which may intermittently function as sink nodes [5][6].

A. TYPES OF CLUSTERING METHODOLOGIES

Centralized clustering protocols offer benefits by eliminating the need for compulsory message passing, thereby reducing the additional overhead on the network. The base station will transmit a message to notify the sensor nodes that will function as cluster heads. Instances of such typed protocols include LEACH-C [7][9][12]. The sole drawback associated with centralized protocols pertains to the requirement of high-capacity and efficiently-managed base stations.

- Distributed algorithms are employed by sensor nodes to determine the most suitable sensor to serve as the cluster head. The selection of the cluster head is determined through the process of message exchange among nodes.
- Power base clustering algorithms take into consideration the remaining battery life of sensor nodes.
- Multi-hop inter-cluster communication refers to the path taken for transmitting data between clusters.
- The process of multilevel clustering serves to confirm the hierarchical structure of cluster heads, indicating that cluster heads possess subordinate cluster heads..

B. CLUSTERING TECHNIQUES DELIVERABLES

1) The moment when the initial node exhausts its energy or ceases to function marks the point at which the cluster-contained network is deemed to be partitioned.[19] This period is commonly known as the network partitioning time. Upon the demise of a node, it will generate offspring in the form of invalid network routes.
2) The second metric that can aid in determining the longevity of a network and the duration it will take to partition is the "mean lifespan of sensors".[8]
3) The phrase "average delay per packet" pertains to the mean duration that a packet requires to traverse from a sensor node to a base station. Energy is commonly regarded as a crucial factor in sensor networks. However, certain real-time critical applications necessitate the transmission of sensory data with minimal interruption of Network.
4) The concept of "throughput" pertains to the proportion of the aggregate quantity of packets that have been received by the base station in relation to the duration of time that has been expended on processing and simulation. A network's superior throughput value indicates its ability to provide improved packet routing.
5) The metric used to evaluate the performance of clustering protocols is the average energy consumed by packets. A reduction in communication energy

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consumption leads to improved network energy savings.

6) The term "Average Power Consumed" refers to the mean power consumption during the transmission of a message. The process involves obtaining values at various intervals throughout the simulation and subsequently calculating their mean. The term refers to the amount of energy utilised by message traffic within a network. [21-22]
7) The standard deviation of load per cluster has been examined in various sensor deployments. The method employed to measure the standard deviation of load involves altering the number of gateways and increasing the sensor count within the network system. There exist a multitude of issues pertaining to clustering that hold considerable importance in the development of a clustering methodology. The fundamental considerations necessary for a properly structured clustering protocol that can yield benefits such as enhanced network longevity, consistent load distribution, and scalability.

IV. GENESIS OF PROBLEM

Wireless Sensor Networks (WSNs) are increasingly gaining prominence owing to their diverse range of applications across various domains, ranging from household to defence surveillance monitoring, vehicular applications, and medical field, among others. The majority of applications necessitate a prolonged network lifespan; however, high-density wireless sensor networks (WSNs) pose significant challenges due to stringent energy limitations. (8, 10)It is important to note that Consequently, they must satisfy several design objectives, such as small node size, low cost, configurability, scalability, reliability, fault tolerance, security, quality of service, low power consumption, among others. Hence, it is imperative for a Wireless Sensor Network (WSN) to effectively address certain critical concerns such as power efficiency, network longevity, and exhibit application-specific capabilities such as change point detection. [17-19]

Clustering methodologies have the potential to address various objectives while also achieving energy efficiency. Centralized clustering protocols exhibit the drawback of increased power consumption by base stations. It has been established that distributive protocols operate based on the residual energy factor, while the residual influence factor is not directly considered. However, a well-known protocol has utilized this factor for probability calculations. It may be worth considering why the Distributive protocol does not solely take into account the residual energy factor. If residual energy is the sole criterion, which technique would sensors employ to select cluster heads? [11,12],[17]

The Improved-Stable Election Protocol (I-SEP), also known as the Extensive Zonal Stable Election Protocol with Threshold Amplification and Residual Energy, is a dynamic hybrid cluster-based heterogeneous hierarchical clustering protocol designed for data transmission. The proposed heterogeneous protocol provides better through at 3rd level heterogeneity.

V. SIMULATION OBSERVATIONS AND EXPLANATIONS

Our proposed ETZ- SEP protocol has following steps for execution. Each MSN is kitted with (GPS), which aids in locating nodes. MSNs are intended to be motionless next positioning.[1] Although all MSNs have similar processing and communication abilities, their initial energy requirements vary (heterogeneous network). MSNs constantly have information to direct toward base station (BS), which is situated separate of the grid or network or in a distant area inside the network.[7]

MSNs are unattended after deployment, making it impossible to replace the batteries.There are no energy, computation, or memory constraints on the network, which only has one BS. Since all nodes have symmetric radio links, data transmission from MSN 'm' will use the same amount of energy as data transmission from MSN 'n'.

By minimizing the distance over which it must transmit data, a sensor node's energy requirements for communicating can be significantly decreased. The IMPROVED-SEP (I-SEP) functions on the theory that data can be sent directly or by passing through a number of intermediate stops. The nodes' locations are necessary in this protocol in order to determine the kind of transmission that each node should respond to. Four different fields were created in the network based on the placement of each sensor node. Each node is given a global positioning system (GPS) and a unique identification number (ID Identification) to help identify the MSN field that it should be assigned to due to their close proximity to the base station; direct communication with MSNs in Area-1 will be much easier. MSN will therefore use straight communiqué to send their facts in this region. MSNs who work in Area-2 are situated close to the BS and through the transmission of their information to the gateway, which then sends it to the base station, these nodes rely on multi-hop transmission. [1-2]

Until all of the data has been transmitted, this process keeps going. Areas 2 and 3 have a lot of MSNs but are located far from the base station. The best method for reducing the amount of energy used in either of these two categories is to group these MSNs into clusters and use optimized approach of routing. In each field, cluster members elect one of their numbers to lead the cluster. This person is in charge of collecting information from the cluster and delivering it to the BS. [2-3],[17]

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Each Member sensor node in each Area field must periodically transmit a packet containing data about the energy level it currently possesses in order to achieve this goal. Additionally, information regarding the energy levels of each node within the same field must be made available. The amount of energy that should be used by each sensor during each round is then calculated using this value. As a result, we are able to calculate the energy held by each sensor node during each round. We will go over the specifics of the plan in this section. The plan that has been suggested primarily consists of the following three main steps:

C. The first step in the process

First thee installation will be done of all the member sensor nodes. This will also be followed by initial energy information, GPS location, and health status of the MSN, distance from the BS and other relevant parameters of the installed nodes of the network.

D. Structure phase

The precise distribution of the regions/ area which is total 4 in number is based upon the position of BS and its distance from fellow MSN in the network. The BS will receive information directly without hoping or going through CH about the MSN placed or located in the region 1 or area 1 which is nearest to the BS. In the region 2/area 2, a gateway is created which actually forwards the data collected on to the Gateway that is immediately nearby, which then sends the information on to the base station. The member sensor Nodes in regions 3 and 4 are grouped together and it is necessary to select a few cluster heads that will be responsible for compiling the data that each cluster member has collected and transmitting it to the BS in the form of a data packet. [1,2], [6], [21]

E. Election of a Cluster Head

In our method, cluster heads are chosen by employing the SEP in the recommended heterogeneous model. CH which is to be use differs depending on the energy that is remaining of the MSNs as well as the equated energy which is average of all the MSNs nearby. Let Pi represent the average likelihood that each node would become CH.

$$r_i = \frac{1}{Pi} \qquad (1)$$

A member sensor node Si can only become CH once every r_i = x rounds. If a node Si is chosen as CH in the present bidirectional flow of information r, it won't be chosen as CH in the next x rounds after that until a minimum threshold number of round have not been passed. The value of ri changes based on the node's remaining energy and the average energy of the region to which it belongs along with the normalized energy. [3], [4] In a heterogeneous wireless network, each MSN has a different value of r in ri since each Member sensor node starts with a distinct quantity of energy having different average energy, residual energy, and normalized energy. This prospect is off course based upon the area the member sensor nodes belong within the network. Furthermore, to maintain normal member sensor nodes from vanishing too rapidly, MSNs with more energy are grouped together for more rounds. This way, all member sensor nodes end up dying at constant pace with equivalent intervals and approximately around same periodic time intervals. Let $N_{1,2}$ be the number of Member sensor in regions 2 and 3, and let P optimal be the number of group- head in each area for each round. The chances that Si will be CH in each round are given by:

$$S_i = P_{optimal} \frac{e_{i\ residual\ (rth)}}{e_{avg}(r)} \qquad (2)$$

$e_{i\ residual}$ (rth) = Residual Energy of MSN at r^{th} round

e_{avg} (r) = Average energy of the Network

$$e_{avg}(r) = \frac{1}{N\,(1,2)} \sum_{i=1}^{i=N} e_i \text{ residual (rth)} \qquad (3)$$

$$\sum_{i=1}^{i=N_{1,2}} P_i = \frac{1}{N\,(1,2)} \sum_{i=1}^{i=N_{1,2}} P_{optimal} \frac{e_{avg}(r)}{e_{i\ residual\ (rth)}} \qquad (4)$$

The middling energy of each sensor member in single round is controller to retain the system running for as long as possible and make sure energy is distributed efficiently.

Elemental source nodes in the same area get information about their neighbor's energy levels from those nodes. However, this can waste energy when receiving data.

By figuring out how much energy they use on average per round, sensor nodes can make smart decisions about how much energy to use, which helps spread energy evenly and progresses network act.

$$e_{avg}(r) = \frac{1}{N\,(1,2)} E_{Total} \frac{R-r}{R} \qquad (5)$$

E_{Total} = Total Energy of the Area (Region)

R = Number of Rounds (Total)

$$R = \frac{E_{Total}}{E_{round}} \qquad (6)$$

$$E_{round} = [D\,(2N_{1,2}\, E_{circuit} + N_{1,2}\, E_{aggregation} + C \times E_{Regenerating} + Q\, \mathcal{E}_{mp}\, t_{bs}^{r} + N_{1,2}\, \mathcal{E}_{fs} t_{ch}^{2})] \qquad (7)$$

In which "D" corresponds to message length, "E" circuits is the energy consumed by the Sensor network circuitry during the transmission, E aggregation is the energy consumption during data collection and manipulating at the member sensor node, C is the number of clusters, E regeneration is the amount of energy consumed during regenerating the message at the Head of the group to transmit the same to the BS. Ɛmp and Ɛfs are amplifier energies; tbs is the average energy between average energy BS and Cluster Head while tch is the mean remoteness untying the

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sensor member group head and the sensor member nodes within the clusters..

$$t_{bs} = 0.8\frac{M}{2} \quad (8)$$

$$t_{ch} = \frac{M}{\sqrt{2\pi C}} \quad (9)$$

To justify and calculate the optimum number of cluster head, "C", we have come up to following expression:-

$$C_{optimum} = \frac{N_{1,2}}{\sqrt{2\pi}} \sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}} \frac{M}{t_{BS}^2}$$

We followed a method similar to the LEACH protocol for choosing the cluster heads in the proposed model. The following definition describes the likelihood verge that each MSN should rely on to determine whether it will act as the cluster head in that round:

$$T(S_k) = \begin{cases} \left\{\frac{p_i E_i(r)}{-p_i} \frac{1}{r \bmod p_i}\right\} \frac{1}{e_{avg}(r)} \\ 0 \end{cases}$$

where $S_k \subseteq H$ (10)

H is a list of all the nodes that could be the head of a groups of sensor members in present bidirectional flow of stream, r. A Member Sensor (S_k), in order to become a CH if it is not cluster head in the preceding ri number of rounds. During every bidirectional round flow of data, if a MSN which is S_k is found to be eligible for becoming CH, then it will arbitrarily select a digit or state between two binary numbers. If the state (number/digit) which is chosen is in a smaller amount than T (S_k) then the given MSN which is being processed becomes CH in the current round.

The three-level heterogeneous network's total initial energy is given as follows:

$$E_{Total} = \{(1+m).X.E_0 + (1+m_0)\}.\{m.X.E_0(1+\alpha) + m_0\}.\{m.X.E_0.(1+\beta)\} \quad (11)$$

The three levels of energy can be categorized using the following equation:-

$$p_i = \left[\frac{p_{optimum}}{(1+m)} \frac{1}{1+m_0} \frac{1}{\beta-\alpha}\right] \times \H{\eta} \quad \text{for normal MSN}$$

$$p_i = \left(\frac{p_{optimum}}{1+m} \times \frac{(1+\alpha)}{(\alpha+m)} \times \frac{1}{(\beta-\alpha)}\right) \times \H{\eta} \quad \text{for advanced MSN}$$

$$p_i = \left(\frac{p_{optimum}}{1+m} \times \frac{(1+\beta)}{(\alpha+m_0)} \times \frac{1}{(\beta-\alpha)}\right) \times \H{\eta} \quad \text{for elite MSN}$$

$$\H{\eta} = \left[\frac{e\ avg\ (r) + e_{i\ residual\ (rth)}}{Q\ (\varepsilon mp\ t_{bs}^{r} + \varepsilon_{fs} t_{ch}^{2})}\right]$$

Member sensor Nodes are dispersed randomly across the network in four zones. A region's total energy will dissipate much more quickly if it only has normal nodes than if it also has advanced and super nodes.

F. Simulation Outcomes

Case 1 :- For rmax=8000 maximum number of rounds in ETZ-SEP with input parameters xm=100; ym=100; n=100; while b=0.5 is an intermediate energy level let's say , the energy is β times more than normal ones, and less than the advanced nodes energy (α) where β = α/2. (α=0.2

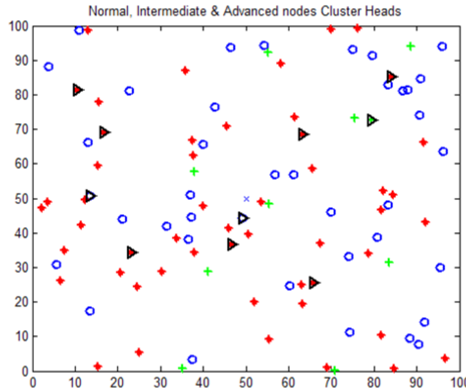

Figure 2. Wireless Sensor Network set Up in MATLAB showing Normal MSN, Advanced MSN and CH (Blue: Normal Nodes; Red: Intermediate Nodes; Green: Advanced Nodes; Black Triangle: Cluster head)

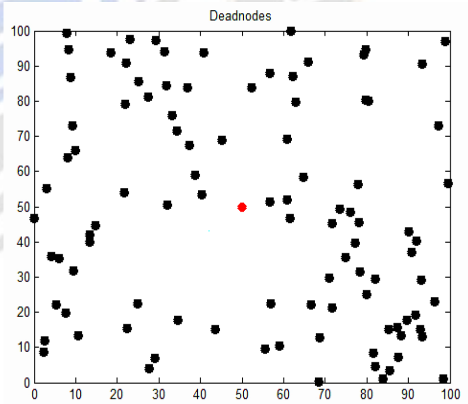

Figure 3 Wireless Sensor Network set Up in MATLAB showing all dead MSN

Black: Dead nodes have more energy is supplied to the active or the sensing nodes and the others that are non-sensing nodes act as dead nodes as there is no energy passed. So in this way we can preserve energy

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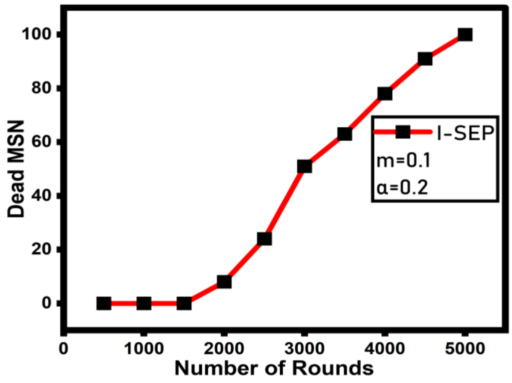

Figure 4- Dead MSN vs Number of Rounds for case-1 for IMPROVED – SEP

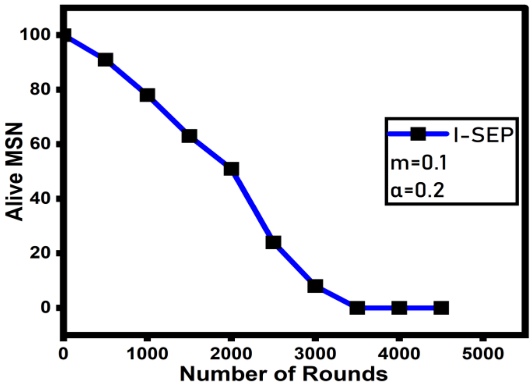

Figure-5 Alive MSN vs Number of Rounds for case-1 for IMPROVED – SEP

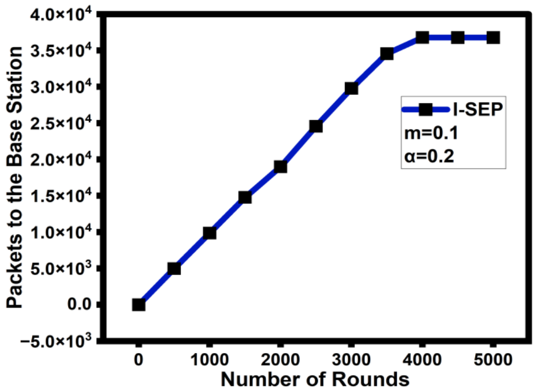

Figure 6-Throughput of the Network for case-1 for IMPROVED – SEP (m=0.1, α=0.2)

Throughput: in order to maximize throughput we introduce a threshold level in the CH selection process.

Case 2:- For n=100; X=y=100; b=0.3; a=1; R=rmax=5000. By calculating the outstanding level of energy and if the cluster head is there with the remaining level of energy greater than the verge value, then the same cluster head is continued to remain as the head of the sensor members group thereby we energy consumption is reduced.so when compared to the previous values, the dead nodes are seen at the round 2900, making stable network.

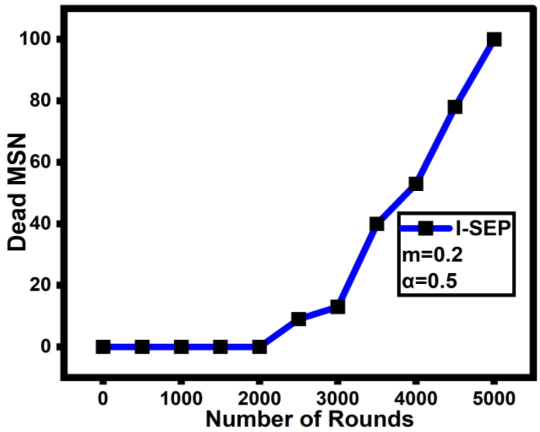

Figure 7-Dead Nodes vs. Number of rounds for Improved- SEP for case-2 scenario

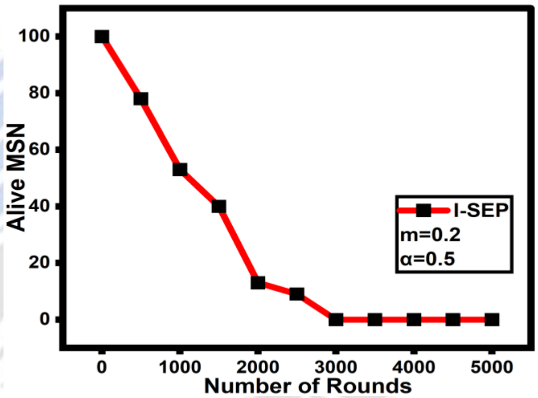

Figure 8-Alive vs. Number of rounds for Improved- SEP for case-2 scenario

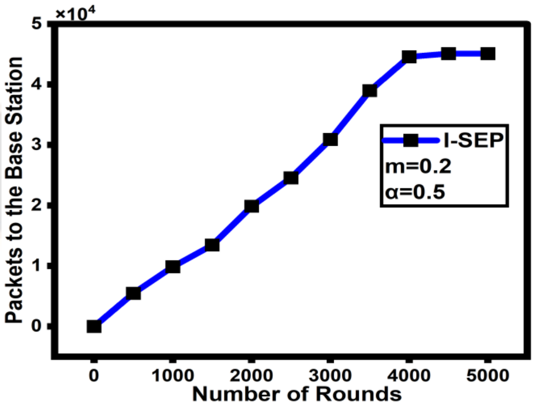

Figure 9- Throughput of the Network for case-2 for IMPROVED – SEP

Case 3:- For r_{max}=5000: (maximum number of rounds) xm=100; ym=100; n=100;

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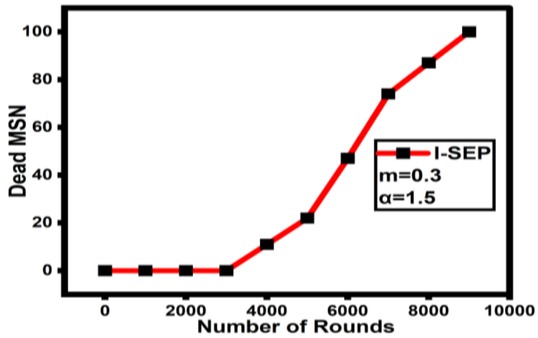

Figure 10- Dead Nodes vs. Number of rounds for Improved- SEP for case-3 scenario

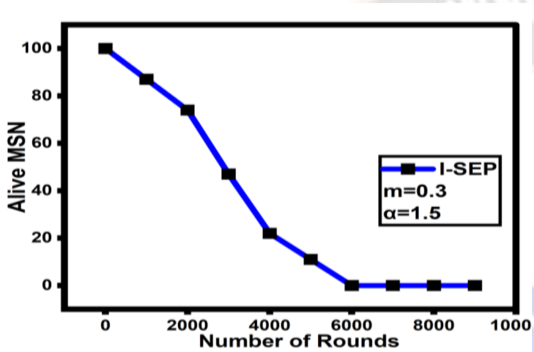

Figure 11- Alive Nodes vs. Number of rounds for Improved for case--4 scenarios

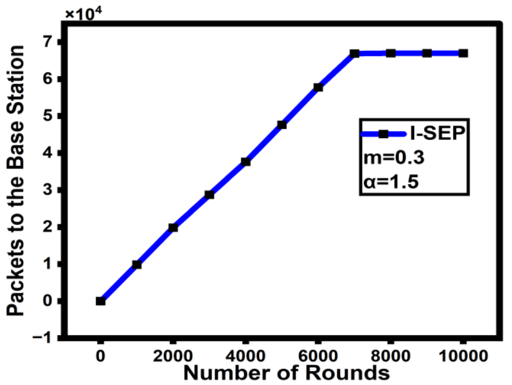

Figure 12- Throughput for Improved- SEP) for case-3 scenario

Case 4:- For rmax=9000 in SEP; xm=100; ym=100; n=100;

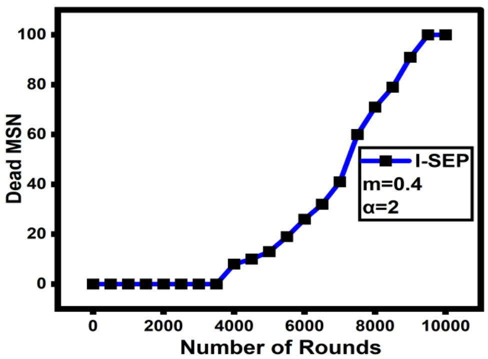

Figure 13- Dead Nodes vs. Number of rounds for Improved for case--4 scenarios

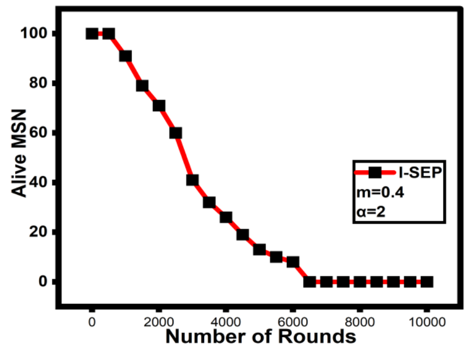

Figure 14- Alive Nodes vs. Number of rounds for Improved for case--4 scenarios

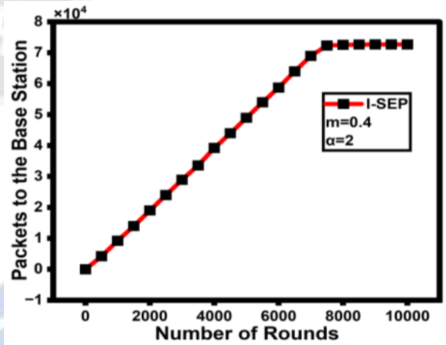

Figure 15- Throughput for Improved for case--4 scenarios

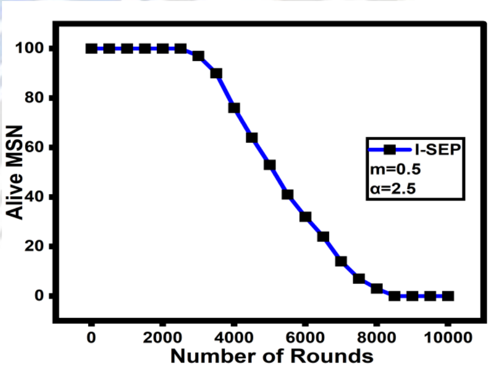

Figure 16 - Alive MSN vs. Number of Rounds for Improved- SEP for case-5 scenario

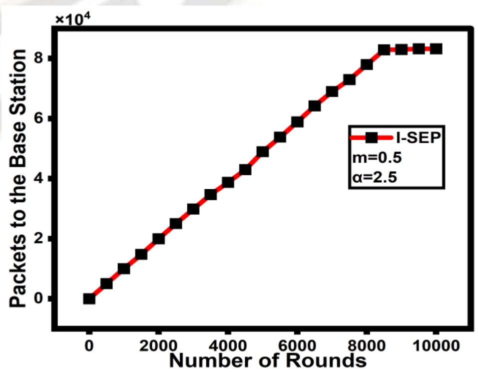

Figure 17-Throughput for Improved- SEP for case-5 scenario

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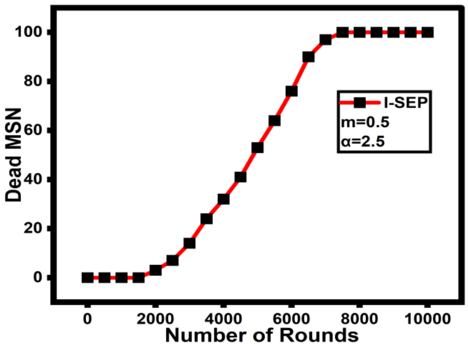

Figure 19-Dead Nodes vs. Number of rounds for Improved- SEP for case-5 scenario

TABLE 1

α	Clustering Technique	m = 0.1	m= 0.2	m= 0.3	m= 0.4	m= 0.5
α=0.2	LEACH	890	898	906	880	913
	SEP	965	1122	1219	1277	1334
	Z-SEP	1032	1010	1080	1050	1048
	Mod-LEACH	913	950	960	979	978
	EZ-SEP	1060	1200	1290	1344	1367
	I-SEP	1185	1290	1395	1433	1488
α=0.5	LEACH	888	999	970	912	845
	SEP	1188	1212	1367	1487	1598
	Z-SEP	1032	998	1080	1050	1132
	Mod-LEACH	913	898	880	912	901
	EZ-SEP	1267	1199	1234	1326	1445
	I-SEP	1301	1389	1505	1587	1632
α=1	LEACH	901	888	930	937	891
	SEP	1234	1278	1398	1545	1698
	Z-SEP	1232	1304	1345	1405	1457
	Mod-LEACH	934	899	913	917	989
	EZ-SEP	1454	1398	1401	1467	1504
	I-SEP	1339	1445	1559	1597	1709
α=1.5	LEACH	901	888	930	937	999
	SEP	1317	1378	1489	1604	1785
	Z-SEP	1401	1454	1564	1643	1803
	Mod-LEACH	996	1013	1001	1035	1078
	EZ-SEP	1498	1606	1678	1789	1805
	I-SEP	1506	1602	1687	1745	1856
α=2	LEACH	1024	1021	1004	1067	1089
	SEP	1423	1399	1456	1478	1502
	Z-SEP	1459	1455	1500	1489	1513
	Mod-LEACH	1003	1009	999	1045	1047
	EZ-SEP	1498	1578	1534	1612	1614
	I-SEP	1423	1488	1534	1666	1701
α=2.5	LEACH	1099	1067	1103	1078	1111
	SEP	1456	1478	1501	1498	1534
	Z-SEP	1467	1534	1499	1545	1589
	Mod-LEACH	998	1078	1113	1145	1178
	EZ-SEP	1513	1587	1634	1685	1717
	I-SEP	1512	1576	1634	1690	1745

Total data cycle to BS for 1st dead MSN keeping m and α as variable for 3rd level of heterogeneity

TABLE 2

α	Clustering Technique	m= 0.1	m= 0.2	m= 0.3	m= 0.4	m= 0.5
α=0.2	LEACH	990	998	1006	980	1015
	SEP	1070	1222	1300	1380	1456
	Z-SEP	1134	1156	1213	1145	1156
	Mod-LEACH	1003	1045	1101	1106	1112
	EZ-SEP	1204	1323	1413	1523	1534
	I-SEP	1298	1367	1478	1523	1609
α=0.5	LEACH	1001	1112	1100	1112	989
	SEP	1310	1340	1470	1505	1635
	Z-SEP	1100	1119	1121	1145	1239
	Mod-LEACH	1013	998	980	1012	1001
	EZ-SEP	1367	1299	1334	1426	1545
	I-SEP	1401	1490	1510	1680	1740
α=1	LEACH	1002	1001	1040	1054	1020
	SEP	1345	1401	1502	1600	1710
	Z-SEP	1323	1425	1521	1535	1608
	Mod-LEACH	1045	1007	1056	1027	1104
	EZ-SEP	1600	1507	1509	1610	1645
	I-SEP	1678	1709	1767	1780	1809
α=1.5	LEACH	1057	1059	1045	1089	1101
	SEP	1450	1567	1657	1756	1899
	Z-SEP	1568	1678	1756	1879	1988
	Mod-LEACH	1098	1123	1234	1322	1487
	EZ-SEP	1650	1759	1867	1988	2024

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	I-SEP	1690	1800	1988	2088	2354
α=2	LEACH	1178	1167	1189	1197	1207
	SEP	1609	1589	1645	1678	1689
	Z-SEP	1589	1545	1599	1690	1756
	Mod-LEACH	1178	1120	1165	1208	1209
	EZ-SEP	1689	1709	1789	1801	1805
	I-SEP	1568	1600	1635	1980	2450
α=2.5	LEACH	1235	1190	1290	1309	1450
	SEP	1605	1645	1701	1759	1910
	Z-SEP	1688	1699	1788	1787	1878
	Mod-LEACH	1120	1234	1289	1356	1459
	EZ-SEP	1780	1790	1905	2010	2439
	I-SEP	1705	1855	2105	2217	2535

Total data cycle to BS for 10th dead MSN keeping m and α as variable for 3rd level of heterogeneity

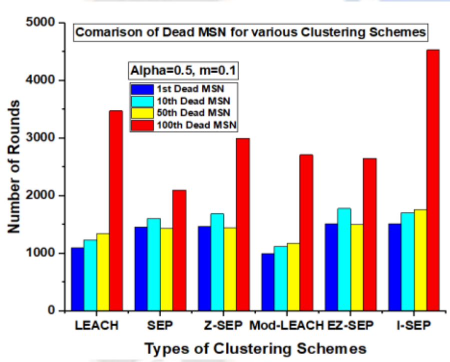

Fig 20(a)- Comparison between multiple clustering Schemes on ground of Dead nodes status

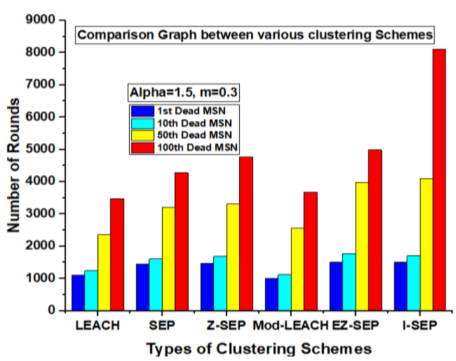

Figure 20 (b)- Comparison between multiple clustering Schemes on ground of Dead nodes status

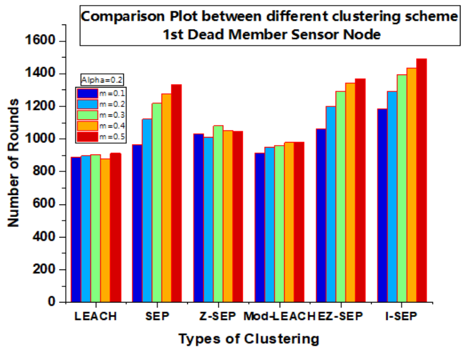

Figure 21(a)- Comparison between multiple clustering Schemes on ground of 1st Dead nodes status at α=0.2

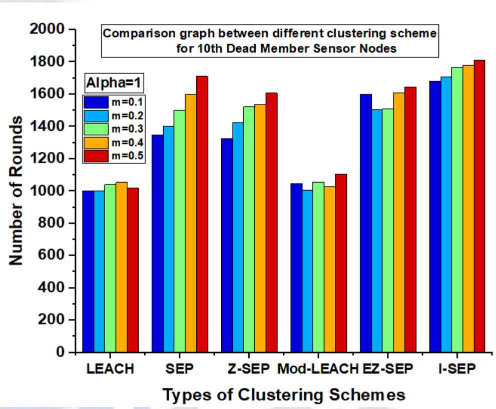

Figure 21(b)- Comparison between multiple clustering Schemes on ground of 10th Dead nodes status at α=1

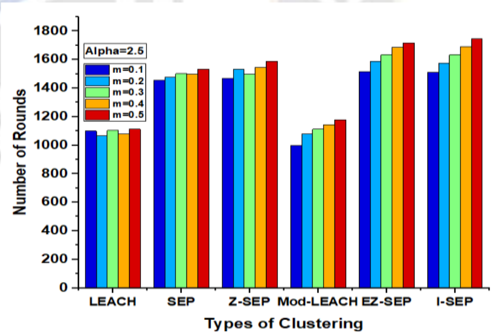

Figure 22(b)-Comparison between multiple clustering Schemes on ground of 1st Dead nodes status at α=2.5

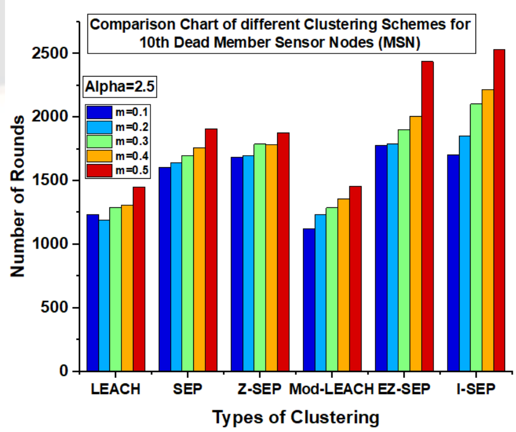

Figure 22- Comparison between multiple clustering Schemes on ground of 10th Dead nodes status at α=2.5

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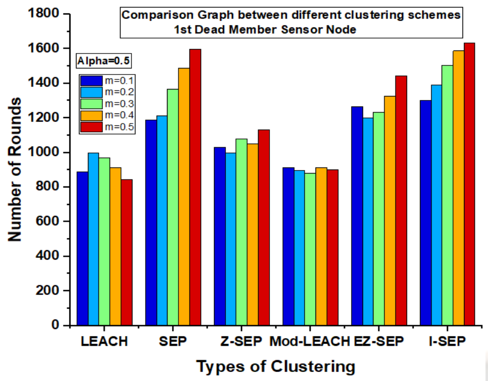

Figure 23- Comparison between multiple clustering Schemes on ground of 1st Dead nodes status at α=0.5

VI. CONCLUSION

In this research work we had reported a heterogeneous IMPROVED-SEP (I-SEP) protocol, which is an enhancement to EZ-SE protocol. The Improved-SEP (I-SEP) network model provides the prospect conserve energy per MSN maintaining a balance for dissipation of consumed energy for all MSN placed in discussed 4 regions. This is done by taking into account each Sensor member primary level of energy with its distance from the destination point. An access collection node or a gateway is situated at the midpoint of the experiential ground with the only accountability of aggregating MSN data and issuing it to the base station.

This is done to avoid the Member sensor from exhausting energy as a result of transmitting for long distances. The simulation outcomes had shown tremendous improvement in Packets transmitted to destination base, (Throughput), and steadiness of the setup using our approach. Dead member sensor per round is tremendously decreased increasing the lifeline of the WCS network by nearly 40% than the existing EZ-SE protocol, 52% more than the existing Z-SEP, 57% more than the existing SEP, and nearly 125% more than the LEACH. The throughput or efficiency has been improved more than by ~ 39%, 43%, 49% ,56%, 53% than EZ-SE protocol, Z-SEP, SEP, Mod-LEACH, and LEACH. Total number of transmitted packet to base station in LEACH and EZ-SE protocol is 350000 and 570000 while in our simulated method gives it around 8750000. The transition rate to become inactive MSN (dead MSN) was very high in LEACH where from 10% to 100% of existing operating MSN becomes inactive within a range of 3000 round of transmission, which is way better in EZ-SE protocol where stability is improved and transition of becoming dead MSN from remaining 10% to 100% will take around 5000-8000 rounds of transmission depending upon heterogeneity. In our method this stability has been improved more than by nearly ~ 37%, 42%, 45%, 49%, 51% at varying the values of m and α between 0.1-0.5 and 0.2-2.5 respectively. In the simulation we reported transition to become inactive MSN from remaining 10% to 100% would be taking around 3500-8500 rounds of transmission between CH and BS depending upon heterogeneity. In our report we had shown all those improvement using MATLAB simulation and graphs (using reading of simulation plotted in Origin) with reading. This reported research had shown very good performance metrics improvement for WCS network with increased throughput, enhanced lifeline of network, enhanced stability of WCS network. Due to the amalgamation of all these enhanced performance metrics, better power optimization will also be possible for all kinds of applications associated with WCS networks. With more better mathematical or meta-heuristic approach incorporating with the presented research, the existing protocol can be made more stable with more number of MSN for larger WCS network setup also.

REFERENCE

[1] I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, A survey on sensor networks, IEEE Commun. Mag. 40 (8) (2002) 102–114.

[2] D. Kandris, C. Nakas, D. Vomvas, G. Koulouras, Applications of wireless sensor networks: An up-to-date survey, Appl. Syst. Innov. 3 (1) (2020) 14.

[3] F. Fanian, M.K. Rafsanjani, Cluster-based routing protocols in wireless sensor networks: A survey based on methodology, J. Netw. Comput. Appl. 142 (2019) 111–142.

[4] S.M. Zin, N.B. Anuar, M.L.M. Kiah, A.-S.K. Pathan, Routing protocol design for secure WSN: Review and open research issues, J. Netw. Comput. Appl. 41 (2014) 517–530.

[5] K.A. Darabkh, S.M. Odetallah, Z. Al-qudah, K. Ala'F, M.M. Shurman, Energy-aware and density-based clustering and relaying protocol (EA-DB-CRP) for gathering data in wireless sensor networks, Appl. Soft Comput. 80 (2019) 154–166.

[6] L.K. Ketshabetswe, A.M. Zungeru, M. Mangwala, J.M. Chuma, B. Sigweni, Communication protocols for wireless sensor networks: A survey and comparison, Heliyon 5 (5) (2019) e01591.

[7] P. Maheshwari, A.K. Sharma, K. Verma, Energy efficient cluster based routing protocol for WSN using butterfly optimization algorithm and ant colony optimization, Ad Hoc Netw. 110 (2021) 102317.

[8] S. Zeadally, F.K. Shaikh, A. Talpur, Q.Z. Sheng, Design architectures for energy harvesting in the internet of things, Renew. Sustain. Energy Rev. 128 (2020) 109901.

[9] P. Rawat, S. Chauhan, Clustering protocols in wireless sensor network: A survey, classification, issues, and future directions, Comp. Sci. Rev. 40 (2021) 100396.

[10] D. Sharma, A. Ojha, A.P. Bhondekar, Heterogeneity consideration in wireless sensor networks routing algorithms: A review, J. Supercomput. 75 (5) (2019) 2341–2394.

[11] S. Arjunan, S. Pothula, A survey on unequal clustering protocols in wireless sensor networks, J. King Saud Univ.-Comput. Inf. Sci. 31 (3) (2019) 304–317.

[12] R.E. Mohamed, A.I. Saleh, M. Abdelrazzak, A.S. Samra, Survey on wireless sensor network applications and energy efficient

routing protocols, Wirel. Pers. Commun. 101 (2) (2018) 1019–1055.

[13] S.K. Singh, P. Kumar, J.P. Singh, A survey on successors of LEACH protocol, Ieee Access 5 (2017) 4298–4328.

[14] W.R. Heinzelman, A. Chandrakasan, H. Balakrishnan, Energy-efficient communication protocol for wireless microsensor networks, in: Proceedings of the 33rd Annual Hawaii International Conference On System Sciences, IEEE, 2000, p. 10.

[15] W.B. Heinzelman, A.P. Chandrakasan, H. Balakrishnan, An application-specific protocol architecture for wireless microsensor networks, IEEE Trans. Wirel. Commun. 1 (4) (2002) 660–670.

[16] A. Shahraki, A. Taherkordi, Ø. Haugen, F. Eliassen, Clustering objectives in wireless sensor networks: A survey and research direction analysis, Comput. Netw. 180 (2020) 107376.

[17] D. Wohwe Sambo, B.O. Yenke, A. Förster, P. Dayang, Optimized clustering algorithms for large wireless sensor networks: A review, Sensors 19 (2) (2019) 322.

[18] L. Xu, R. Collier, G.M. O'Hare, A survey of clustering techniques in WSNs and consideration of the challenges of applying such to 5G IoT scenarios, IEEE Internet Things J. 4 (5) (2017) 1229–1249.

[19] M. Mukhtaruzzaman, M. Atiquzzaman, Clustering in vehicular ad hoc network: Algorithms and challenges, Comput. Electr. Eng. 88 (2020) 106851.

[20] F. Engmann, F.A. Katsriku, J.-D. Abdulai, K.S. Adu-Manu, F.K. Banaseka, Prolonging the lifetime of wireless sensor networks: A review of current techniques, Wirel. Commun. Mobile Comput. 2018 (2018).

[21] P.K. Mishra, S.K. Verma, A survey on clustering in wireless sensor network, in: 2020 11th International Conference On Computing, Communication and Networking Technologies (ICCCNT), IEEE, 2020, pp. 1–5.

[22] B.M. Sahoo, H.M. Pandey, T. Amgoth, GAPSO-H: A hybrid approach towards optimizing the cluster based routing in wireless sensor network, Swarm Evol. Comput. 60 (2021) 100772.

[23] A.S. Rostami, M. Badkoobe, F. Mohanna, A.A.R. Hosseinabadi, A.K. Sangaiah, et al., Survey on clustering in heterogeneous and homogeneous wireless sensor networks, J. Supercomput. 74 (1) (2018) 277–323.

[24] J. Liang, Z. Xu, Y. Xu, W. Zhou, C. Li, Adaptive cooperative routing transmission for energy heterogeneous wireless sensor networks, Phys. Commun. 49 (2021) 101460.

[25] P. Vadicherla, D. Vadlakonda, Study on energy efficient routing protocols scheme in heterogeneous wireless sensor networks (network & mobility), Mater. Today: Proc. (2021).

[26] G. Smaragdakis, I. Matta, A. Bestavros, SEP: A Stable Election Protocol for Clustered Heterogeneous Wireless Sensor Networks, Tech. rep., Boston University Computer Science Department, 2004.

[27] L. Qing, Q. Zhu, M. Wang, Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks, Comput. Commun. 29 (2006) 2230–2237.

[28] R. Khan, An efficient load balancing and performance optimization scheme for constraint oriented networks, Simul. Model. Pract. Theory 96 (2019) 101930.

[29] E. Niewiadomska-Szynkiewicz, a. Sikora, J. Kołodziej, P. Szynkiewicz, Modelling and simulation of secure energy aware fog sensing systems, Simul. Model. Pract. Theory 101 (2020) 102011.

[30] S. Lindsey, C.S. Raghavendra, PEGASIS: Power-efficient gathering in sensor information systems, in: Proceedings, IEEE Aerospace Conference, Vol. 3, IEEE, 2002, p. 3.

[31] A. Manjeshwar, D.P. Agrawal, TEEN: Arouting protocol for enhanced efficiency in wireless sensor networks, in: Ipdps, Vol. 1, (2001) 2001, p. 189.

[32] O. Younis, S. Fahmy, HEED: A hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks, IEEE Trans. Mobile Comput. 3 (4) (2004) 366–379.

[33] D. Mahmood, N. Javaid, S. Mahmood, S. Qureshi, A.M. Memon, T. Zaman, MODLEACH: A variant of LEACH for WSNs, in: 2013 Eighth International Conference On Broadband and Wireless Computing, Communication and Applications, IEEE, 2013, pp. 158–163.

[34] Rao I, U. M. ., & Sastry, J. K. R. . (2023). Average True Range Approach for Resource Scheduling and Allocation in Cloud Computing Networks. International Journal of Intelligent Systems and Applications in Engineering, 11(2s), 189 –. Retrieved from https://ijisae.org/index.php/IJISAE/article/view/2522

[35] S. Dai, X. Jing, L. Li, Research and analysis on routing protocols for wireless sensor networks, in: Proceedings. 2005 International Conference On Communications, Circuits and Systems, 2005, Vol. 1, IEEE, 2005, pp. 407–411.

[36] S. Singh, A. Malik, hetSEP: Heterogeneous SEP protocol for increasing lifetime in WSNs, J. Inf. Optim. Sci. 38 (5) (2017) 721–743.

[37] D. Singh, C.K. Panda, Performance analysis of modified stable election protocol in heterogeneous wsn, in: Proceedings of the 2015 International Conference On Electrical, Electronics, Signals, Communication and Optimization (EESCO), Visakhapatnam, India, 2015, pp. 24–25.

[38] A. Singh, H.S. Saini, N. Kumar, D-MSEP: Distance incorporated modified stable election protocol in heterogeneous wireless sensor network, in: Proceedings Of 2nd International Conference On Communication, Computing and Networking, Springer, 2019, pp. 271–281.

[39] P. Saini, A.K. Sharma, Energy efficient scheme for clustering protocol prolonging the lifetime of heterogeneous wireless sensor networks, Int. J. Comput. Appl. 6 (2) (2010) 30–36.

[40] N. Javaid, T. Qureshi, A. Khan, A. Iqbal, E. Akhtar, M. Ishfaq, EDDEEC: Enhanced developed distributed energy-efficient clustering for heterogeneous wireless sensor networks, Procedia Comput. Sci. 19 (2013) 914–919.

[41] B. Elbhiri, R. Saadane, D. Aboutajdine, et al., Developed distributed energy-efficient clustering (DDEEC) for heterogeneous wireless sensor networks, in 2010 5th International Symposium On I/V Communications and Mobile Network, IEEE, 2010, pp. 1–4.

[42] S. Singh, A. Malik, R. Kumar, Energy efficient heterogeneous DEEC protocol for enhancing lifetime in WSNs, Eng. Sci. Technol. Int. J. 20 (1) (2017), 345–353.

[43] X. Chen, W. Qu, H. Ma, K. Li, A geography–based heterogeneous hierarchy routing protocol for wireless sensor networks, in: 2008 10th IEEE International Conference On High Performance Computing and Communications, IEEE, 2008, pp. 767–774.

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[44] H. Zhou, Y. Wu, Y. Hu, G. Xie, A novel stable selection and reliable transmission protocol for clustered heterogeneous wireless sensor networks, Comput. Commun. 33 (15) (2010) 1843–1849.

[45] X. Ma, Y. Fang, X. Bai, A balanced energy consumption clustering algorithm for heterogeneous energy wireless sensor networks, in: 2010 IEEE International Conference On Wireless Communications, Networking and Information Security, IEEE, 2010, pp. 382–386.